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(54) Title: COMPUTERIZED MODELING SYSTEM AND METHOD

(57) Abstract: A modeling system and method for describing large volume purchasing of travel services and for predicting shifts in service supplier market and shares that are dependent on changes in the volumes of purchases by a purchaser of travel services. The system and method uses input travel service provider data to calculate quality of service indices and uses those calculated results with input travel service purchaser data to generate scenario models describing large volume purchasing of travel services and to calculate predicted shifts in service supplier market shares as caused by input changes in the volumes of purchases by a purchaser of travel services. The predicted shifts in service supplier market shares are used to negotiate agreements between service purchasers and suppliers, and to monitor achievement of performance goals.

BACKGROUND OF THE INVENTION

1. Field of the Invention

The present invention relates in general to the field of modeling large volume purchasing of services and predicting shifts in service supplier market shares that would result if particular changes in the volumes of purchases were to be made, and, more particularly, to computer systems and methods usable by corporate travel department managers for predicting effects on separate airline market shares caused by shifts between airlines in the volume of airline tickets purchased by the corporation.

2. Discussion of the Prior Art

Travel management is a discipline practiced over a very broad range of sophistication. At the lower end is the individual planning a trip who needs to have airline schedules searched to learn which flights might be taken to make a trip, and who has to inquire as to the prices for airline tickets for flights that might be taken. On the basis of such information a trip can be planned, tickets purchased and the trip taken. At the upper end are large groups, including businesses, that employ managers to project, recommend and implement multi-trip travel cost budgets. Such groups can negotiate with airlines for contracts including provisions granting them ticket price discounts, some of which discounts being tied to the numbers of tickets the group buys. On the basis of projections the travel managers of such groups, *e.g.*, corporations, are

supposed to develop, recommend and then implement long term plans including strategies for negotiation of contracts with airlines.

In recent years a range of computer-based systems and methods have been developed and used to assist in travel management. Those that are relevant here are intended for use by travel managers for large groups.

Among these computer-based systems and methods are a group of systems intended for trip planning that select flight itineraries from published airline scheduled flights for a trip which comply with input corporate travel policies and traveler preferences, and further select and identify those flight itineraries for trips with the lowest fares. Examples of such computer systems are described in U.S. Patent Nos. 5,021,953 and 5,331,546, which issued from a continuation application of the application from which 5,021,953 issued. A variation of the computer system and method from that described in the preceding two identified patents is one described in U.S. Patent No. 5,237,499 whereby using the described computer system and method an individual business traveler may additionally book an itinerary, including airline flights, hotel reservations and, if necessary, ground transportation. According to U.S. Patent No. 5,237,499, tickets for the selected itinerary are purchased at fares that were previously negotiated between

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airlines and the group employing the individual business traveler.

These described computer systems and methods all take the current airline flight schedules, current fares and current corporate travel policies as inputs and process that data to select flight itineraries that can be purchased at the then existing fares which are lowest. No predictions are calculated as to effects on sales of airline tickets that could result from multiple travelers being offered different flight schedules or discount fare rates.

Multiple variations of such computer systems and methods that essentially process large volumes of existing flight schedule and fare data, including fare discount information, by sorting and scoring flight itineraries and fares have been developed. Further examples include the computer system and method described in U.S. Patent No. 4,862,357 which is supposed to be able to screen out unacceptable and unavailable flights while displaying for an operator flights scored in accordance with preloaded travel policies, airline preferences and layover restrictions/requirements. One computer system and method described in U.S. Patent No. 5,191,523 determines the number of connecting segments flown, the number of miles flown, the anticipated amount of time from departure to arrival, and the costs on per-hour and per-mile bases for the selected itineraries.

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A more recent computer system and method described in U.S. Patent No. 5,832,453 is supposed to be usable to develop a model to represent a group's travel requirements in order to optimize selection of multiple itineraries purchased from airlines. Inputs for this computer system and method include existing airline flight schedules, fares, the discounts that the group has available from airline databases, and the trips that the group's members have to make. Using such data the described computer system and method is supposed to construct an objective function that represents a travel cost to the group to purchase travel trips for a plurality of travelers who would take various specified trips, and the computer system and method also is supposed to construct constraints from input trip demand and airline flight data, including any airline utilization goal data for the group. Then the constraints are applied to the objective function, according to the description set out in the 5,832,453 patent using linear programming, to determine a solution for the objective function that satisfies the constraints and thereby identifies minimized travel costs for the group.

All of these prior computer systems and methods are supposed to take existing airline flight schedules, current fares and current group travel policies as inputs, and process that data to identify those flight itineraries which can be purchased at the lowest then existing fares. No pre-

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dictions are calculated as to effects on sales of airline tickets that could result from multiple travelers of a group being offered different fight schedules or discount fare rates.

SUMMARY OF THE INVENTION

In a preferred embodiment, the present invention provides a method and apparatus for corporate travel managers to use computers to develop models of the airline markets in which their corporations buy tickets. Then, using the present invention, a corporate travel manager can vary the model defining parameters so as to predict shifts in separate airline market shares. Developing air travel models and calculating predictions using the present invention enables corporate travel managers to investigate different situations and forecast how best to negotiate contracts with airlines for the purchase of tickets, including how to evaluate offered airline contract terms, how to more accurately develop travel budgets and manage travel expenditures.

By being able to forecast future air travel market situations with calculated predictions, the present invention provides corporate travel managers with information not previously available. Instead of only calculating a single optimal solution, that may or may not realistically be achievable, the present invention permits

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calculations of predictions for multiple models controlled by the corporate travel manager so that a preferred option or a range of options can be evaluated for implementation.

In the past, automated systems were developed to select trip itineraries from existing airline schedules and fares. As such, they do not support the corporate travel managers in the tasks of projecting, evaluating and then dynamically monitoring travel programs.

The present invention is provided with airline schedules, airline ticket fares, ticket discount rates, corporate travel projections by city and airport pairs from and to which trips are expected to be made, and other data described below. Utilizing this data under a set of rules described below, the present invention calculates by a series of multiplications quantities labeled quality of service indices that are percentage numbers representative of airline service between cities and airports. Then, inputting additional data such as airline contract data, preference data for airlines, and other travel specific data, the corporate travel manager using the present invention constructs travel scenarios. These defined travel scenarios in combination with the calculated quality of service index values are used to determine predicted market shares for specific airlines providing flight services between cities and airports.

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It is the sensitivity of the determined airline market share values to variations in input parameter values such as corporate preference levels for specific airlines that corporate travel managers can use to forecast what travel management plans would or would not be best for their corporations.

Software to implement the present invention can be loaded on a server connected to the Internet so that corporate travel managers, for a license fee, can access the software using their corporate personal computers to run computerized simulations of travel scenarios and predict resulting air travel scenario details. Alternatively, the software can be licensed or sold to corporate customers so that corporate travel managers can load the software on corporate computers for use.

BRIEF DESCRIPTION OF THE DRAWINGS

Fig. 1 illustrates a schematic view of one apparatus embodiment of the present invention; and

Figs. 2 through 6 show block diagrams for an embodiment of the present invention in serial order with data input steps, databases, calculation steps and outputs identified.

DETAILED DESCRIPTION OF PREFERRED EMBODIMENT

Referring to the drawings, a preferred embodiment for an apparatus of the present invention, which is implemented

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as an Internet based system, is shown in Figure 1, and this Internet-based apparatus is generally designated by reference numeral 10. More specifically, the apparatus 10 includes a modeling server 12, the Internet 14, and multiple individual customer personal computers 16. This embodiment for the present invention uses unmodified commercially available equipment for all of the modeling server 12 and customer personal computers 16. Software to execute the method of the present invention, which is described in detail below, is loaded in the modeling server 12, and the Internet-based apparatus 10 shown in Figure 1 is preferably implemented to operate compatibly using 3.X browsers, e.g., Microsoft Internet Explorer® and Netscape Navigator® software loaded in the customer personal computers 16. For such usages, software to execute the method of the present invention is Hyper Text Markup Language (HTML) based. Using this embodiment, individual corporate travel executives, for license fees, can with corporate personal computers 16 connect via modems through the Internet 14 to address and access, on secure bases (again implemented using techniques known to those skilled in the art) the modeling server 12 to run computerized simulations for predicting resulting travel scenario parameter values.

Other apparatus embodiments for the present invention will be recognized by those skilled in the art upon study of the method disclosed below including directly loading

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software to execute the method of the present invention on customer computers.

Operation of the apparatus 10, to effect travel scenario constructions and predictions in accordance with a preferred embodiment of the present invention is illustrated using input steps, database construction, calculation steps, and output steps form, *i.e.*, flow chart form, in Figs. 2 through 6 for a preferred embodiment as now described.

Data identified below is collected in order to make calculations, using the method of the present invention, whereby values for travel scenario parameters resulting from input data are calculated. Additionally, some of the collected data is input to calculate intermediate parameter values that are then used for making further calculations according to the method of the present invention to predict final parameter values for resulting travel scenarios.

Referring to Fig. 2, geographic, airline, and airline commission rate data, including updates for such data, is input at a Maintain System Reference Tables 200 step. The geographic and airline data is then input into a System Reference Tables 210 database. The geographic data includes specific identifications of continents, countries or regions, through the levels of states, cities and specific airports, *e.g.*, North America and Europe, and the included countries, cities and airports that are relevant to corporate clients who use the present invention to analyze

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travel scenarios. The input airline data includes (a) the names of airlines or carriers providing service between airports in the selected geographic database, and (b) the classes of service provided by each included airline on its specific flights, *e.g.*, first, business or coach classes which are usually respectively designated as F, C, Y, as well as additional classes including various discounted classes, such as B, M, Q, K, etc. The data in the System Reference Tables 210 database is updated as changes in facts warrant (*e.g.*, opening of a new airport, introduction of a new airline service, or termination of a prior airline service).

Standard airline commission rate data is also collated and input at the Maintain System Reference 200 step, and is then input to a Standard Airline Commission Rates 220 database. Such data includes airline specified standard commission rates credited for tickets purchased at various locations for travel between locations included in the System Reference Tables 210 database and also input are the maximum commission rate amounts, *i.e.*, segment caps. For example, if tickets are issued in the U.S. for travel on a carrier within the U.S., then that carrier may offer a commission rate of 5% but this standard commission rate may be segment-capped at $25.00, and, in such a case, the data for that carrier would be collated at the Maintain System

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Reference Tables 200 step and input to the Standard Airline Commission Rates 220 database.

Travel industry standardized data setting out what airlines serve what airports, their flight schedules and the type of service are input to a Flight Table 230 database. This data for a preferred embodiment can be directly loaded into the Flight Table 230 database from compact discs ("CD's") that are sold by suppliers known in the travel industry.

Several sets of factors labeled quality of service indices are calculated at a Generate Quality of Service Index 240 step and are stored at a Quality of Service Index 250 database, *e.g.*, for a preferred embodiment, three sets of quality of service indices would be generated; namely, one set for each airline that operates between city pairs, a second set of quality of service indices for each airline that operates between specific airport pairs, and a third set of quality of service indices associated with each pair of airports serviced by each airline that operates between two cities. Such sets of quality of service indices are all calculated using data from the System Reference Tables 210, Flight Table 230, and Airport Pairs 260 databases. Quality of service indices are calculated percentage parameters that are intended to be representative of available air travel services provided between city/airport pairs by carriers. The sum of all calculated quality of service indices for

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each of the types of quality of service indices, *e.g.*, all carriers providing service between a pair of cities, is adjusted to have a fixed value of 100%.

Data stored in the Airport Pairs 260 database is provided with identifications of the actual pairs of airports and associated cities that are to be used for calculating predictions for travel scenarios between the included airport pairs and associated cities.

Individual quality of service index values are calculated at the Generate Quality of Service Index 240 step, as follows:

A. Carrier flights for which quality of service indices are to be calculated are categorized according to routings as follows (the examples set out below are for airport pairs; variations required for city pairs are direct and self-evident extensions):

- A category of non-stop routing flights are identified as those flights for which the Flight Table 230 and the Airport Pairs 260 databases specify that the locations of each flight's origin and destination airports are the same as those for which quality of service indices are to be calculated.
- A category of one-stop routing flights are identified as those flights for which the

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Flight Table 230 and the Airport Pairs 260 databases specify that an included flight's origin airport is the same as that for which quality of service indices are to be calculated and the destination airport of this first flight is an airport other than the second airport of the specified pair of airports but such first destination airport is also the origin airport of a second flight for the routing. The location of the destination airport for the second flight is the same as the second airport in the specified pair of airports.

- A category of two-stop routing flights are identified as those flights for which the Flight Table 230 and the Airport Pairs 260 databases specify that a flight's origin airport is that for which quality of service indices are to be calculated. The destination airport of this first flight must both be different from that of the second airport of the specified pair and also be the origin airport of a second flight having a - destination airport that is also different from the second airport of the specified pair. The destination airport of the second

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flight must be the origin airport of a third flight, but the destination airport of the third flight must be the same airport as that of the latter of the pair of specified airports.

B. The one- and two-stop routings are then evaluated by applying the following rules to determine those that are legitimate connecting flights:

- The dates for the first and last flights for each routing must overlap, *i.e.*, all flights for the routing operate on the same day.
- The flights for each routing operate on the same days of the week, except when one or more flights may arrive on a day earlier or later than when it departed due to operating over the International Dateline or operating past midnight.
- The flights for each routing must have connecting times for either domestic or international flights, depending on the situation, that are equal to or greater than minimum connecting times which are pre-set for periods officially specified for the relevant airports or are set at essentially optimal periods of time that are determined from previously using the method of the

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present invention, *e.g.*, for a preferred embodiment minimum connecting times of 1.0 hour for domestic flights and 1.5 hours for international flights were effectively utilized. Maximum connecting times are pre-set for periods customary within the industry, *e.g.*, for a preferred embodiment maximum connecting times of 4.0 hours for domestic flights and 6.0 hours for international flights, not counting the hours between 10:00 p.m. and 6:00 a.m., were effectively used. Routings for the preferred embodiment are excluded if they originate and terminate within the same country but have connections through airports in a second country.

- A primary carrier is specified for each routing by identifying the carrier that operated (or code shared, as is known in the travel industry) on the longest flight within the routing as determined by mileage.

C. Initial raw quality of service index values now are calculated for each non-stop routing and legitimate connecting routing by calculating the product of all the following factors:

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(a) One-half the least number of seats on each airplane for the routing in the travel service category, e.g., F, C, Y, etc., for which quality of service indices are being calculated. When a routing operates on a code-share basis, the flight seats are divided evenly between each of the listed code-share flights. An exemplary value for this factor would be 62.5 for the situation where the number of seats on an airplane is 125, *i.e.*, 0.5 x 125 = 62.5.

(b) Aircraft type factor determined from a previously loaded table of pre-set values, which for a preferred embodiment have a range of values from 0.5 (for helicopters, and propeller aircraft with 50 or fewer seats), 0.7 (for propeller aircraft with 70 or fewer seats), 0.8 (for propeller aircraft with more than 70 seats), 0.9 (for narrow bodied jet with 70 or fewer seats), 0.95 (for narrow bodied jets with more than 70 seats), 1.0 (for narrow bodied jets with 100 or more seats), to 1.1 (for wide bodied jets), *e.g.*, Boeing 757 could have a value of 1.0;

(c) For the situation where there are routing connections, a connection penalty factor is

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determined from a previously loaded table of pre-set values, which for a preferred embodiment have a range of values from 0.06 to 0.75, *e.g.*, a connecting flight in an airport pair where the minimum elapsed time is one hour could have a factor value of 0.06.

(d) Departure time factor determined from a previously loaded table of pre-set values, which for a preferred embodiment in value from 0.5 (for 11 p.m. to 4 a.m.), 0.7 (for 8 a.m. to noon), to 1.0 (for 6 a.m. to 8 a.m. and for 4 p.m. to 6 p.m.), *e.g.*, 7:30 a.m. could have a value of 1.0.

(e) Arrival time factor determined from a previously loaded table of pre-set values, which for a preferred embodiment range in value from 0.5 (for 11 p.m. to 4 a.m.), 0.7 (for 8 a.m. to noon), to 1.0 (for 6 a.m. to 9 a.m. and for 4 p.m. to 6 p.m.), *e.g.*, 6:00 p.m. could have a value of 1.0.

(f) Factor for the combination of the departure time of a legitimate connecting flight departure time and an alternative departure time for the closest routing with a lower number of connections determined from a previously loaded table of pre-set values, which

BNSDOCID: <WO___0161607A1_I_>

for a preferred embodiment range in value from 0.4 (for situation of flights having the same departure times) to 1.0 (for situation of flights having a 4 hour or more departure time difference for the nearest non-stop flight.), *e.g.*, in the case of a one-stop legitimate connecting routing with a 9:00 a.m. departure and an alternative non-stop routing also with a 9:00 a.m. departure, the pre-set value could be 0.40;

(g) Factor value for the number of days per month that a selected flight route is made by a carrier. For a preferred embodiment this factor value is set at the actual number of days per month that the airline provides such service. This factor, for the preferred embodiment, is adjusted in value according to which day or days of the week the flight is made. Specifically, for the preferred embodiment, the factor is retained at its full value if the flights are made on any of Monday through Friday. Whereas, if the flights are made on Saturday or Sunday, the factor is multiplied by 0.25, and if the flights depart on Friday and arrive on Saturday or depart on Sunday and arrive on

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Monday, the factor is multiplied by 0.50. Therefore, in the situation where a selected flight route is made every day during the month of June, the factor value for the preferred embodiment, is calculated as follows: (22 x 1.0 + 8 x 0.25) = 24.

The initial raw quality of service index value that would be calculated for the above set-out exemplary values, *i.e.*, (a) through (h), is 62.5 x 1.0 x 0.06 x 1.0 x 1.0 x 0.4 x 24=36.0.

D. Final quality of service index factor values are now calculated as follows:

- A summation of all the initial raw quality of service index values for non-stop and legitimate connecting routings made by an actual or code-share carrier servicing a pair of airports is determined and the value of that summation is then divided by the summation of all the initial raw quality of service index values for non-stop and legitimate connecting routings for all the carriers servicing that airport pair.
- In those cases where the previous summations and ratio calculations are less than a preset value (which is found by prior use of the present invention to be a threshold for

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eliminating essentially meaningless values, *e.g.*, 1% for a preferred embodiment), the below threshold values are deleted to provide an intermediate set of quality of service index values and the intermediate quality of service index values for the carrier servicing the airport pair are redistributed so that the sum of all the values for all the carriers providing service between each included airport pair is 100%. Such redistribution is effected, for a preferred embodiment, by first calculating the ratio of one divided by the summation of all the intermediate quality of service index values and then multiplying that value by the individual quality of service index values to calculate the final individual redistributed quality of service index values.

The final individual calculated quality of service index values are input to the Quality of Service Index 250 database.

Now, computerized data for the corporate client using the present invention to calculate travel scenario parameter values that is available from travel agencies (*e.g.*, from computerized databases such as those known as Global Max®, ADS/X, Sabre Travel Base®, and others) and from the cor-

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porate client's own in-house computerized databases (*e.g.*, from computerized database systems such as those known as GEMS, ISP, VantagePoint®, and others) is directly input to a Back Office Data 270 database.

Data for the corporate client is also output from the System Reference Tables 210, Back Office Data 270 and the Back Office Numbers 280 databases and is input to the Standardized Back Office Data 290 step where the input data for the corporate client is transformed into a common format for use in the method of the present invention. (Identifications of the travel agencies, the types of data systems the agencies use and their assigned client numbers are stored in the Back Office Numbers 280 database.) Additionally, specific customer identification numbers are set at unique values and are assigned to each of the individual data sets for the individual corporate clients. The transformed data is then output from the Standardized Back Office Data 290 step and is input to the Standardized Back Office Data 300 database.

Next, airline contract data for the corporate client is input at the Corporate Travel Department 310 step, and this data is next entered into the Airline Contracts 320 database (see Fig. 3). This contract data is updated as is necessary to keep the data in the system current for that corporate client.

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Specifically entered into the Airline Contracts 320 database are (a) airline identifications, (b) contract effective dates, (c) point-of-sale discounts (including applicable geography --origin and destination airport, city, state, country and/or regions), (d) applicable classes of service, (e) types of discount (*e.g.*, flat rate, percentage, or class-of-service upgrade), (f) whether travel under the contract is eligible for commission and/or override earnings, (g) back-end discounts (including applicable geography, type of discount (cash or barter), frequency of payment (annual or quarterly), delay in payment (from end of year or quarter, etc.), amount of discount, and whether travel under the contract is eligible for commission and/or override earnings), and (h) performance targets (including system level targets, focused market targets and individual airport pair targets), which may be revenue and/or segment targets, either absolute, percentage or growth based, in all or just served markets.

Data identifying corporate preferred carriers and the level of corporate influence used to affect preference decisions is also input at the Corporate Travel Department 310 step and is entered into the Historical Preferred Carriers and Influence 330 database. The entered preference and influence data is generated from interviews with the corporate travel manager(s) and, as appropriate, other corporate travel management executives. Carrier preferences

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are segmented historically, *e.g.*, on a month-by-month basis, and, therefore, those carriers, during the associated time periods, that are identified by corporate travel management executives as being preferred carriers are so designated, depending on the travel management executive's preference, to specific airports, cities, states, countries, regions or, even, system-wide. Influence levels, which also are segmented on a month-by-month basis, are digitized to represent the overall level of corporate travel compliance influence -- a combination of policy, communication, and point of sale effectiveness (for a preferred embodiment this data is specified on a scale of values ranging from 0 to 5, with 0 being used for no influence, 1 being used for a mild corporate influence, and 5 being used for a corporate mandate with the values 2 through 4 being used for the respective intermediate levels of influence). Optionally, the corporate client may also enter digitized values to represent overriding influence levels for specified carriers serving specific airport pairs that are identified in the Historical Preferred Carriers and Influence 330 database. Again the overriding influence levels are assigned values for a preferred embodiment that range from 0 to 5.

Data from a Standard Airline Commission Rates 340 database, which include information on the commission rates and segment caps for travel between pairs of countries or regions for tickets issued in specified countries by a

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carrier, is input to a Nonstandard Airline Commission and Override Rates 350 step. Currently, for example, when tickets are issued in the United States for travel within the United States the commission rate can be 5% with a cap of $25.00 per segment.

The data from the Standard Airline Commission Rates 340 database is now compared at the Nonstandard Airline Commission and Override Rates 350 step to the corporate client's data available at the Corporate Travel Department 310 step to extract nonstandard airline commission rates and override rates that are input to the separate Nonstandard Airline Commission Rates 360 database and the Override Rates 370 database. Override rates are additional earnings returned to the corporate client under contract specified conditions for travel with the identified carriers.

The corporate client now selects an analysis strategy using all of that client's data input from the Corporate Travel Department 310 step or a subset of it (see Fig. 4). For example, subsets may be selected by the corporate client based on a range of variables, such as invoice dates (*i.e.*, tickets issued between certain dates), geography (*i.e.*, tickets issued in certain countries or tickets issued for travel from, to or through certain airports, cities, countries or regions, or excepting travel from, to or through certain airports, cities, countries or regions), or travel characteristics (*i.e.*, minimum or maximum distance, minimum

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or maximum fare). Specifically, the corporate client's analysis elections are exercised at the Enter Analysis Data Selection Parameters 400 step and the selected data is input to the Analysis Data Selection Parameter 410 database.

At a Backout Contracts and Summarize Data 420 step the data stored in the Analysis Data Selection Parameters 410 database is combined with data from the Standardized Back Office Data 300, Standard Airline Commission Rates 340, Nonstandard Airline Commission Rates 360, and Override Rates 370 databases to:

- Calculate the mileage from origin to destination airport for each segment (A segment is the movement of one passenger on a flight from one airport to another. If a traveler flies from Washington to Chicago, the trip is one segment. If a person flies from Washington to Seattle and connects in Chicago, the total Washington-Seattle trip consists of two segments. If a person flies from Washington to Chicago, stops over for a night, and flies to Seattle the next day, the two days of travel are two segments. A round trip from Washington to Chicago is two segments.);
- Eliminate (*i.e.*, collapse) connections between segments in the database for travel on the same tickets using standard rules for connection times;

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- Allocate fares to each actual or collapsed segment using the following rules:
  - If there is fare data for each segment stored at Standardized Back Office Data 300 and the sum of the fares is within 10% of the total ticket fare, (*i.e.*, there may be airport tax or other miscellaneous charges that increase the total ticket fare) the fare data is used as is;
  - If fare data is missing for certain segments, but the sum of the fares for the segments having designated fares is within 10% of the total ticket fare, then the fares for the segments having designated fares are allocated pro rata to the segments without designated fares using mileage and cabin factors, *e.g.*, fare rates for first, business or coach cabins; and
  - If the sum of the segment fares is more than 10% different from the total ticket fare, then fares are allocated pro rata to all of the segments using mileage and cabin factors.
- Determine which contracts could be applied to each segment by comparing carrier, date of travel, airport pair and class-of-service data with data for contract provisions. If multiple contracts

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are found that might be applied, the one which results in the largest discount is designated to be applied.

- Determine the commission and override discounts using the contract information stored in the Standardized Back Office Data 300, the Standard Airline Commission Rates 340, Nonstandard Airline Commission Rates 360, and Override Rates 370 databases.
- If a contract with a point-of-sale discount is identified as applicable, then, using the contract information stored in the Standardized Back Office Data 300 database, the fare that would be paid if the contract had not been applied is calculated using the algorithm: Fare That Would Be Paid = Fare Paid/(1 - Percentage Discount Rate Applied).
- If a contract with a point-of-sale discount is identified as applicable, then the commission and override discounts that would be earned on the non-discounted fare are determined using data from the Standard Airline Commission Rates 340, the Nonstandard Airline Commission Rates 360, and the Override Rates 370 databases.
- If a contract with a back-end, (*i.e.*, after sale) discount is identified as applicable, the amount of that back-end discount is determined.

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- If multiple tickets may be issued due to airline contract rules, connections are eliminated (*i.e.*, collapsed) between segments on the separate tickets having the same passenger name record ("PNR") for the same traveler using rules for connection times that are standard in the industry.
- The resulting data at this point is then filtered using the information stored in the Analysis Data Selection Parameters 410 database to identify the data relevant to the scenario being analyzed.
- The determined and filtered data from the previous step is next categorized by ticketing country, airport pair, carrier, fare category (first, business, or full coach, discounted coach, or "junk" fares), invoice month, month of travel and this resulting data is stored in the Summarized Back Office Data 430 database.
- The calculated, filtered and categorized data from the Backout Contracts and Summarize Data 420 step is identified by carrier, and the so identified by carrier data is then stored in the Summarized Carrier Data 440 database.
- The calculated, filtered and categorized data from the Backout Contracts and Summarize Data 420 step also is identified by airport pairs, and the so

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identified by airport pair data is stored in the Summarized Airport Pair Data 450 database.

At this point the data from the Summarized Carrier Data 440 database is presented via Hyper Text Markup Language ("HTML") output, paper printout or other output to the corporate client, who selects which carriers to include in the analysis, *i.e.*, see Select Carriers for Analysis 460 step. Data for all carriers included in the Summarized Carrier Data 440 database that is not selected for use is collectively identified as "All Other Carriers".

Similarly, the data from Summarized Airport Pair Data 450 database is presented to the corporate client, who selects the number of airport pairs to include in the analysis, *i.e.*, see Select Airport Pairs for Analysis 470 step. The number of airport pairs is determined outside the system by the corporate client, based on that corporate client's expectation of the number of airport pairs that will cover a sufficient portion of the travel data for the desired travel scenario, *e.g.*, 75% of the corporation's travel budget for a specified time period. The list of selected specific airport pairs is that stored in the Airport Pairs 260 database which served as input for calculating quality of service indices for each of the selected airport pairs.

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Average non-discounted fares are determined for each ticketing country, airport pair and fare category and these are stored in an Average Fares 490 database.

The data stored in the Summarized Back Office Data 430 database now is processed at the Create Project Baseline 480 step. Specifically, for each ticketing country, airport pair, carrier, type of service and invoice month combination included in the Summarized Back Office Data 430, Summarized Data 440 and Summarized City Pair Data 450 databases, determinations are made at the Create Project Baseline 480 step which identify every airport pair included in the Summarized Airport Pair Data 450 database that is not included in the Airport Pairs 260 database. The airport pairs that are included in both the Airport Pairs 260 and Summarized Airport Pair Data 450 databases are stored in the Summarized Baseline Data 500 database. Therefore, the data for airport pairs stored in the Summarized Baseline Data 500 database is the same as that stored in the Summarized Back Office Data 430 database except those airport pairs not included in the Summarized Airport Pairs 260 database have been explicitly identified as being summarized in total. Similarly, the data for city pairs stored in the Summarized Baseline Data 500 database is the same as that stored in the Summarized Back Office Data 430 database except those city pairs not included in the Summarized City Pair Data 450

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database have been explicitly identified as being summarized in total.

The following steps setting up a set of parameters for making simulation runs (also referred to as scenario calculations) are now executed.

The corporate client utilizing a preferred embodiment for the present invention, now uses the data collected at the Corporate Travel Department 310 step to directly enter at the Setup Simulation Scenario 510 step of one of three types of data sets into the Simulation Scenario Parameters 520 database (see Fig. 5). The first type, called a "blank slate", has no airline contract, preferred carrier, minimum influence, or other data, *i.e.*, a blank data set. The second type, called a "current actual environment", includes data for all existing airline contracts, preferred carriers, and influence levels. The last type, called "existing scenario", maintains the data already stored in the Simulation Scenario Parameters 520 database without addition or deletion.

If the corporate client entered a "blank slate" in the Simulation Scenario Parameters 520 database, then the corporate client at the Setup Contract Scenario 530 step identifies information from the Corporate Travel Department 310 step and the Airline Contracts 320 database for a set of airline contract data for a travel scenario to be analyzed and inputs that set of data into the Contract Scenario 540

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database. Alternatively, if at this step the corporate client desires to modify airline contract data previously entered at the Setup Simulation Scenario 510 step, such modifications are made and the revised airline contract data is entered into the Contract Scenario 540 database.

If the corporate client entered a "blank slate" in the Simulation Scenario Parameters 520 database, then the corporate client at the Setup Preferred Carrier Scenario 550 step identifies information from the Corporate Travel Department 310 step for a set of data for preferred carriers and inputs that set of data into the Contract Preferred Carrier 560 database. Alternatively, if at this step the corporate client desires to modify the preferred carrier data entered at the Setup Simulation Scenario 510 step, such modifications are made and the altered preferred carrier data is entered into the Preferred Carrier Scenario 560 database.

If the corporate client entered a "blank slate" in the Simulation Scenario Parameters 520 database, then at the Setup Airport Pair User Defined Trip Distribution 570 step, the corporate client enters estimated share numbers for each included carrier servicing the selected airport pairs into the User Defined Trip Distribution 580 database. To do this the corporate client defines trip distributions to specify desired results for a particular airport pair. Alternatively, if at the Setup Airport Pair User Defined Trip

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Distribution 570 step, the corporate client desires to make data modifications, such modifications are made and the altered predicted share numbers are entered into the User Defined Distribution 580 database.

If the corporate client entered a "blank slate" in the Simulation Scenario Parameters 520 database, then at the Setup Airport Erosion Scenario 590 step, the corporate client enters airport predicted erosion scores into an Airport Erosion Scenario 600 database which represents an estimate of the percentage of corporate travelers that would be willing or able to move their travel departures or arrivals to another airport. Alternatively, if at the Setup Airport Erosion Scenario 590 step, the corporate client desires to make data modifications, such modifications are made and the altered airport erosion scores are entered into the Airport Erosion Scenario 600 database.

At this point data previously entered into the following databases is applied to the data stored in the Summarized Baseline Data 500 database to calculate predicted simulation parameter values at the Run Scenario Simulation 610 step for the travel scenario formulated by the collected data: (see Fig. 6)

Simulation Scenario Parameters 520;
Contract Scenario 540;
Preferred Carrier Scenario 560;
User Defined Trip Distribution 580;

BNSDOCID: <WO___0161607A1_I_>

Airport Erosion Scenario 600; and,

Quality of Service Index 250 databases.

It is the following calculations that are now executed at the Run Scenario Simulation 610 step for the ticketing country, airport pair, type of service and month data that has been entered into the Summarized Baseline Data 500 database.

First, the preferred and non-preferred carriers are identified for the specified airport pairs using the Preferred Carrier Scenario 560 database. A raw predicted share is determined for the preferred carriers as a group using the sum of the quality of service index values for each of those carriers. A predicted share also is determined for the non-preferred carriers as a group using the sum of the quality of service index values for each of those carriers.

Using an input influence level that has been specified for the scenario being run, a predicted share value is determined from one of multiple curves defined by formulae incorporated and utilized at the Run Scenario Simulation 610 step. For a preferred embodiment, there are eleven such curves, each of which includes two or three straight line segments. The two straight line curves include initial straight line segments that linearly run from the origin point (0%quality of service index value, 0% predicted share value) to initial inflection points, and second straight

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line segments that run from the first inflection points to the final point (100% quality of service index value, 100% predicted share value). For the three straight line curves, an initial straight line segment runs from an origin point (0% quality of service index value, 0% predicted share value) to a first inflection point, a second straight line segment runs from the first inflection point to a second inflection point, and a third straight line segment runs from the second inflection point to the final point (100%quality of service index value, 100% predicted share value). Other embodiments of the invention can use curves having other numbers of straight line segments, non-linear curves, or combinations of straight line segments and non-linear curves adjusted to fit real world or extrapolated data.

The inflection points for the predicted share value curves for a preferred embodiment of the present invention are as follows:

- In the cases of preferred carriers with influence level values ranging from 1 through 4, the predicted share value curves have single inflection points, but in the case of preferred carriers with an influence level value of 5 the predicted share value curve has two inflection points. The inflection point values for these curves are set out in Table I below:

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Table 1
Preferred Carrier Inflection Point Values

Influence Level Value	Predicted Share Value Curve Inflection Points At:
1	(60% quality of service index value, 66% predicted share value)
2	(60% quality of service index value, 72% predicted share value)
3	(60% quality of service index value, 84% predicted share value)
4	(45% quality of service index value, 84% predicted share value)
5	(10% quality of service index value, 17% predicted share value) and (25% quality of service index value, 84% predicted share value)

- In the case of non-preferred carriers with influence level values ranging from 1 through 4, the predicted share value curves have single inflection points, but in the case of a non-preferred carrier with an influence level value of 5 the predicted share value curve has two inflection points. The inflection point values for these curves are set out in Table II below:

Table II
Non-Preferred Carrier Inflection Point Values

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Influence Level Value	Predicted Share Value Curve Inflection Points At:
1	(40% quality of service index value, 34% predicted share value)
2	(40% quality of service index value, 28% predicted share value)
3	(40% quality of service index value, 16% predicted share value)
4	(55% quality of service index value, 16% predicted share value)
5	(75% quality of service index value, 16% predicted share value) and (90% quality of service index value, 83% predicted share value)

These predicted share values for the group of preferred and non-preferred carriers are next distributed to the respective individual carriers in proportion to each carrier's share of the total quality of service index values for the group.

After all of the predicted share values have been calculated for the input ticketing countries, airport pairs, carriers and months, the data excluded up to this point on the basis of airport erosion values is introduced and predicted share values are now calculated for the input airport pairs in accordance with the above-described processes.

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The predicted share values for each carrier that have quality of service index scores above a threshold level that is set by the corporate client (*e.g.*, the U.S. Department of Transportation recommends 10% and for a preferred embodiment a value of 5% was effectively used) are calculated for the input airport pairs and months.

The predicted share values are next multiplied by the corresponding segment total values and average fare amounts (incorporating point-of-sale discounts, contract discounts, commission discounts and override amounts) stored in the Summarized Baseline Data 500 database.

The calculated predicted share output values are further processed at the Run Scenario Simulation 610 stage so as to be categorized by airport pair, carrier, type of service and month for input to the Scenario Output 620 database from which the corporate client can read the results of the simulation run.

For each ticketing country, airport pair, type of service and month, the average fare from the Average Fare 490 database is multiplied by the number of segments to determine an estimated non-discounted fare that would be charged. The appropriate airline contract, if any, is determined from the Contract Scenario 540 database, and the point of sale discount, if any, is then directly calculated. Commission and override amounts are determined from appropriate airline contract, standard and company specific

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airline commission and override rates. The back end discount, if any, is calculated. Each of these -- the point of sale discount, commission, override amount and back end discount -- are multiplied by the number of segments and output with the ticketing country, airline pair, type of service and month from the Scenario Output 620 database.

The above described preferred embodiment of the present invention can repeatedly be used to construct scenarios having input defining parameter values corresponding to those of interest to a corporate travel manager, and to calculate predicted travel parameter values for the different scenarios. Such determinations can then be used by the corporate travel manager to evaluate the feasibility and desirability of implementing one or more of the studied travel scenarios.

Those skilled in the art will recognize that the method and apparatus of the present invention has many applications, and that the present invention is not limited to the representative examples disclosed herein. Moreover, the scope of the present invention covers variations and modifications to the systems and methods described herein, as would be known by those skilled in the art.

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What is claimed is:

1. A method to model multiple trip air travel scenarios for trips made by employees of a user, and to predict different air carrier share rates for the scenarios; the method is implemented using at least one computer having a data storage device for storing data in a database repository, the method comprising:

creating an air carrier flight schedule database, an air carrier ticket price and discount price database, and geographic locations database;

determining quality of service index values for air carriers and storing the determined quality of service index values in a database;

creating (i) an air carrier contracts and preferred air carrier database for the user, (ii) an user defined trip distribution database, and (iii) proportions of user travelers able to change airports for travel departures and arrivals database;

determing predicted air carrier utilization share rates and storing the predicted share rates in a database;

inputting different proportion values for the user travelers able to change airports for travel departures and arrivals and entering the changed proportion values in a database for a changed air travel scenario;

determining predicted air carrier utilization share rates for the changed proportions of user travelers able to change airports for travel departures and arrivals and entering the predicted share rates in a database; and

evaluating the stored predicted share rates to assess the feasibility of implementing the different air travel scenarios.

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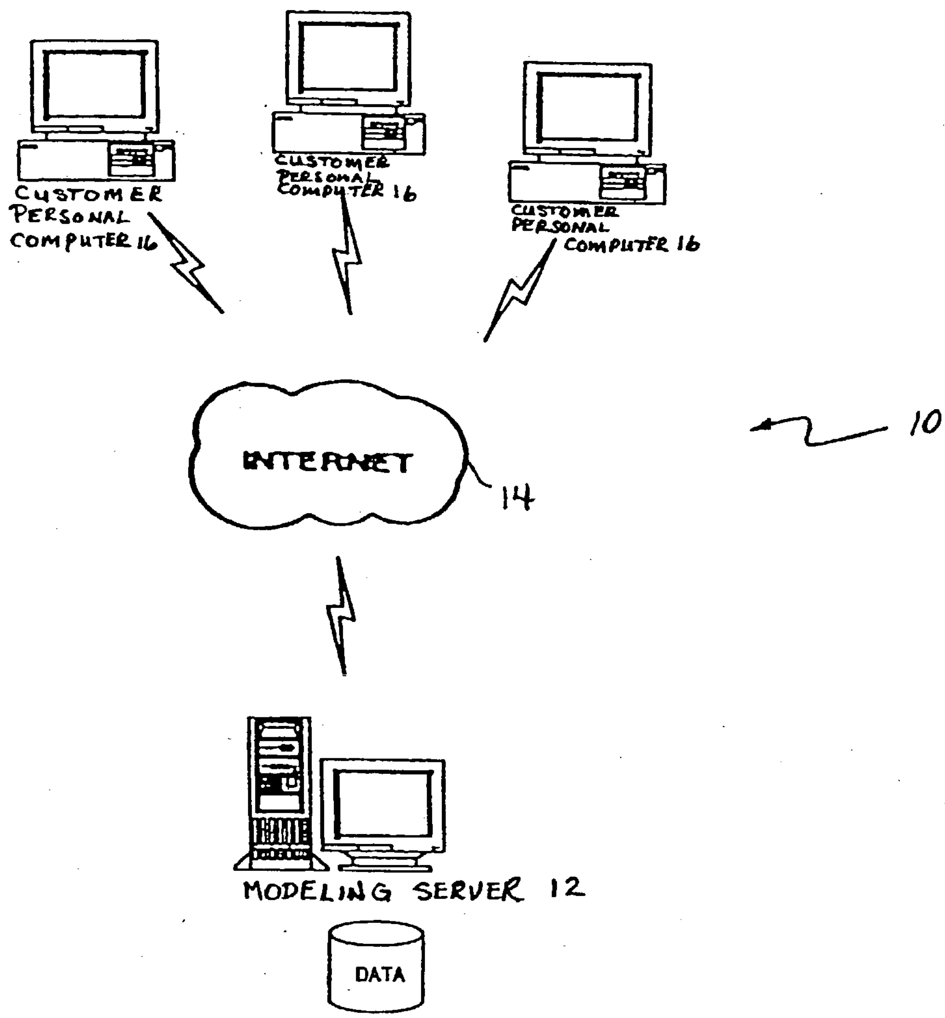
CUSTOMER PERSONAL COMPUTER 16
CUSTOMER PERSONAL COMPUTER 16
CUSTOMER PERSONAL COMPUTER 16
INTERNET
14
10
MODELING SERVER 12
DATA

FIG 1

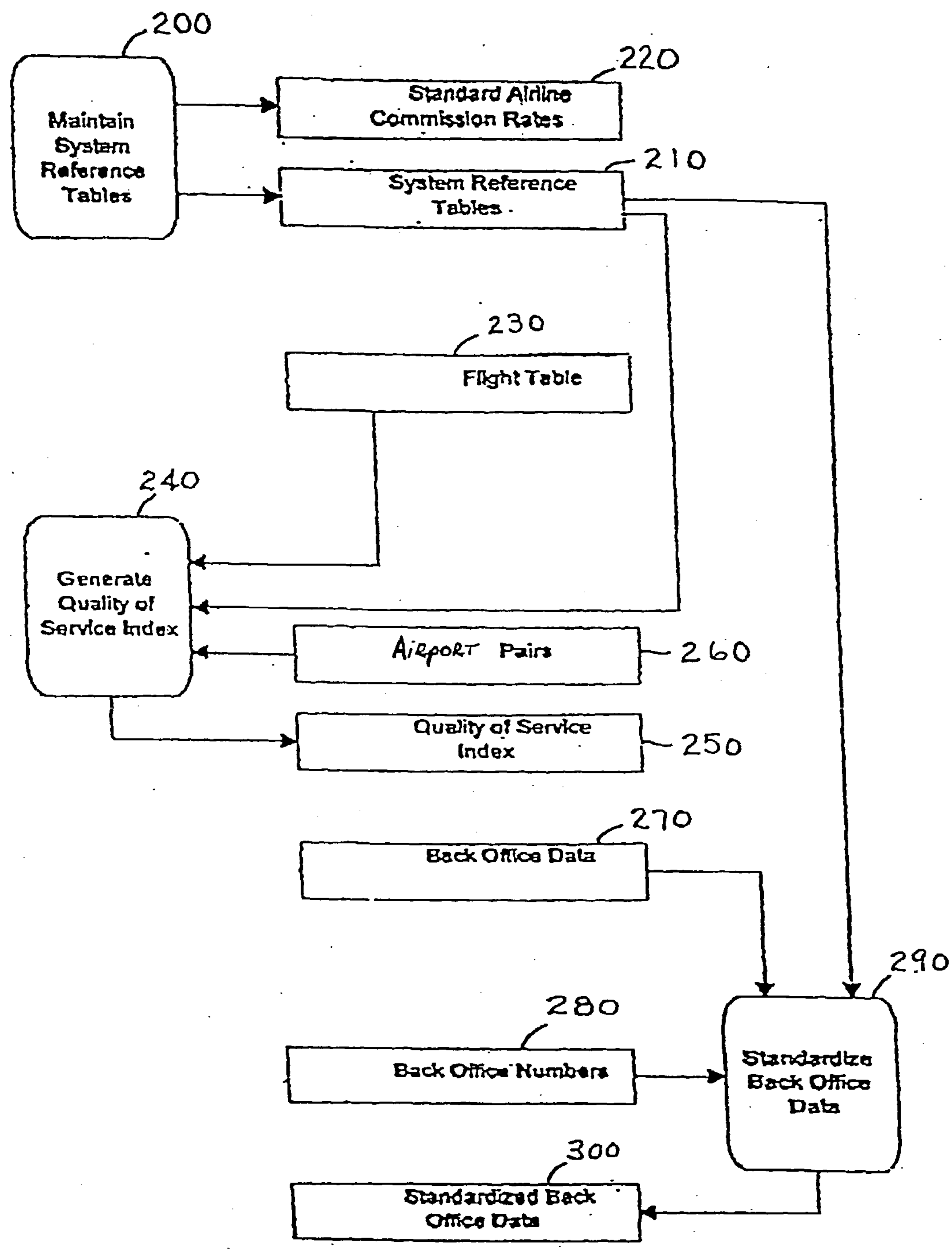
200
Maintain System Reference Tables
220
Standard Airline Commission Rates
210
System Reference Tables
230
Flight Table
240
Generate Quality of Service Index
AIRPORT Pairs
260
Quality of Service Index
250
270
Back Office Data
290
280
Back Office Numbers
Standardize Back Office Data
300
Standardized Back Office Data

FIG. 2

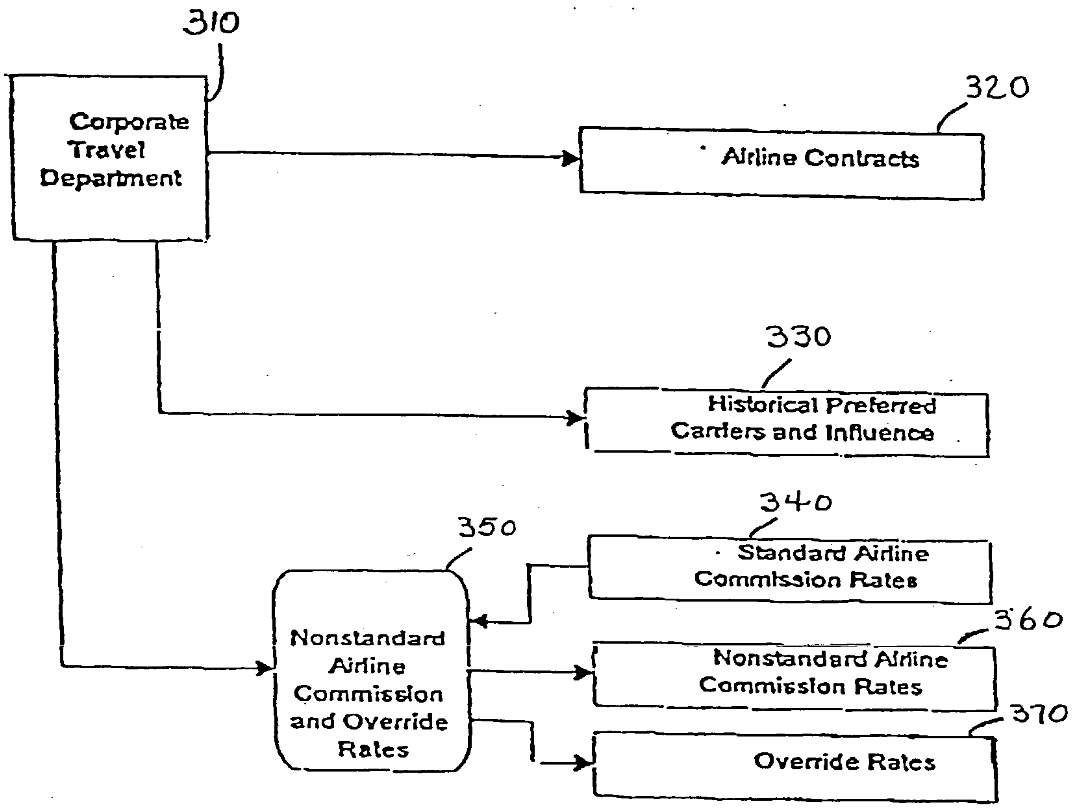
310
Corporate Travel Department
320
Airline Contracts
330
Historical Preferred Carriers and Influence
340
Standard Airline Commission Rates
350
Nonstandard Airline Commission and Override Rates
360
Nonstandard Airline Commission Rates
370
Override Rates

FIG. 3

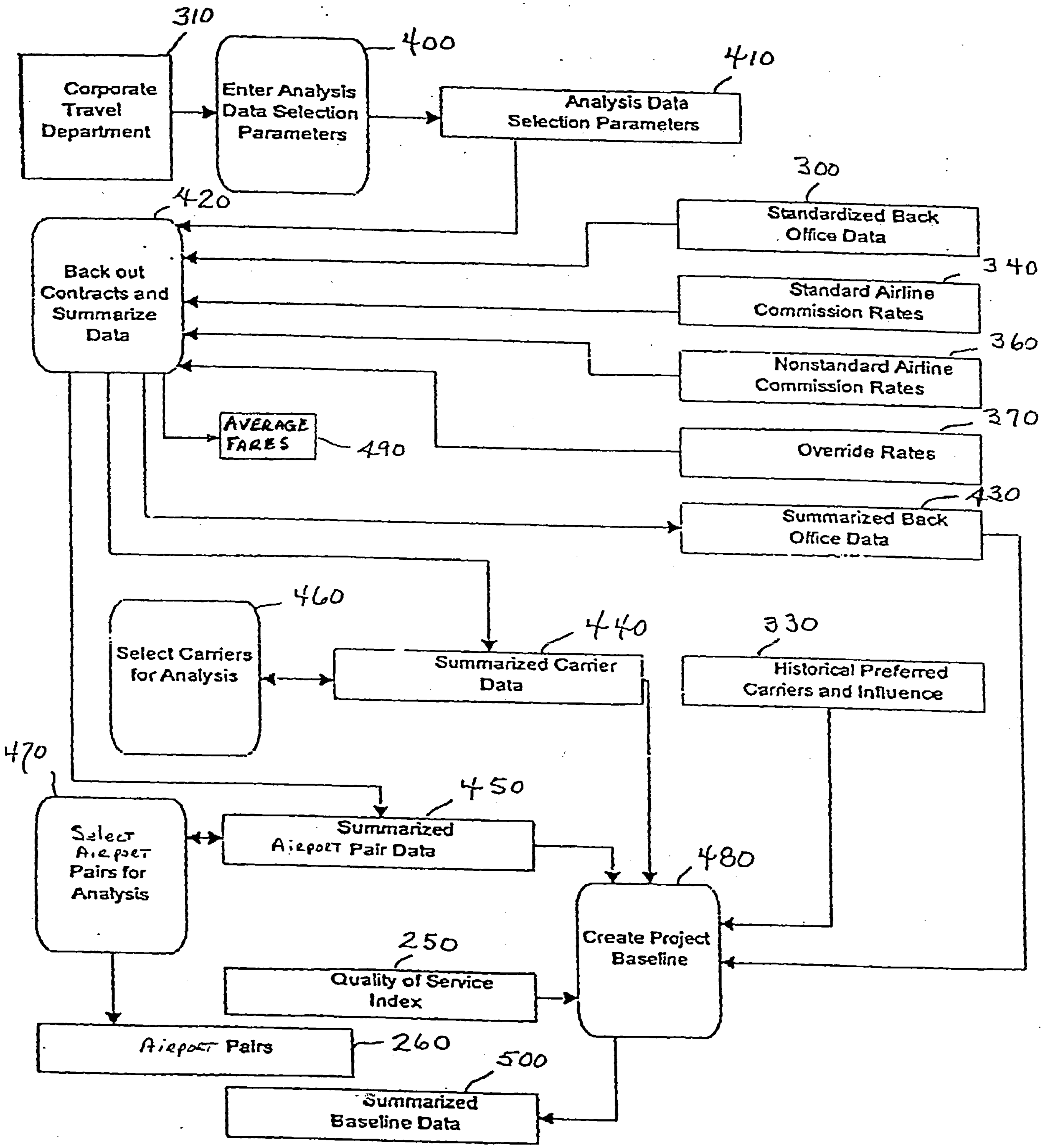
310
Corporate Travel Department
400
Enter Analysis Data Selection Parameters
410
Analysis Data Selection Parameters
420
Back out Contracts and Summarize Data
300
Standardized Back Office Data
340
Standard Airline Commission Rates
360
Nonstandard Airline Commission Rates
370
Override Rates
AVERAGE FARES
490
430
Summarized Back Office Data
460
Select Carriers for Analysis
440
Summarized Carrier Data
330
Historical Preferred Carriers and Influence
470
Select Airport Pairs for Analysis
450
Summarized Airport Pair Data
480
Create Project Baseline
250
Quality of Service Index
Airport Pairs
260
500
Summarized Baseline Data

FIG. 4

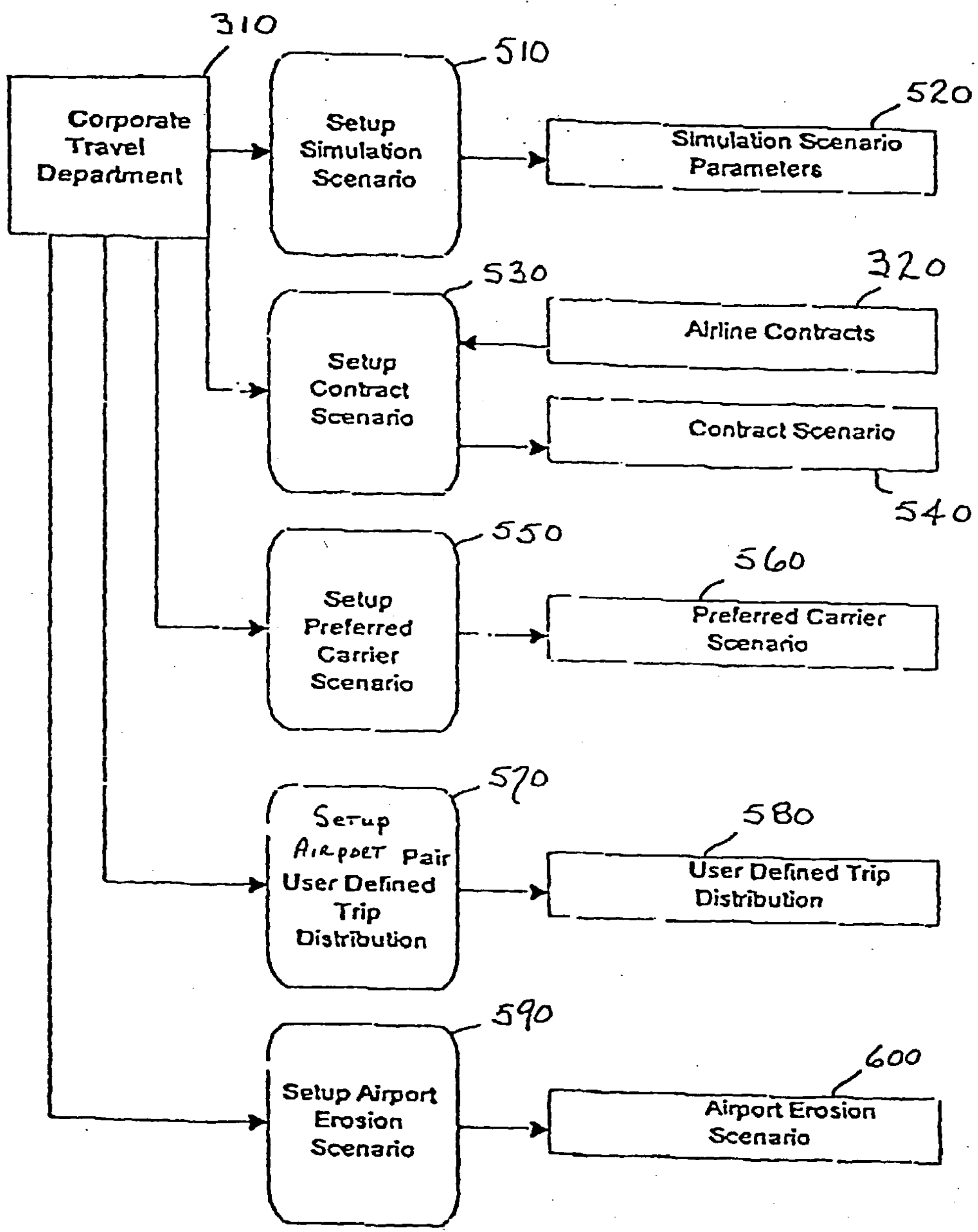
310
Corporate Travel Department
510
Setup Simulation Scenario
520
Simulation Scenario Parameters
530
Setup Contract Scenario
320
Airline Contracts
Contract Scenario
540
550
Setup Preferred Carrier Scenario
560
Preferred Carrier Scenario
570
Setup Airport Pair User Defined Trip Distribution
580
User Defined Trip Distribution
590
Setup Airport Erosion Scenario
600
Airport Erosion Scenario

FIG. 5

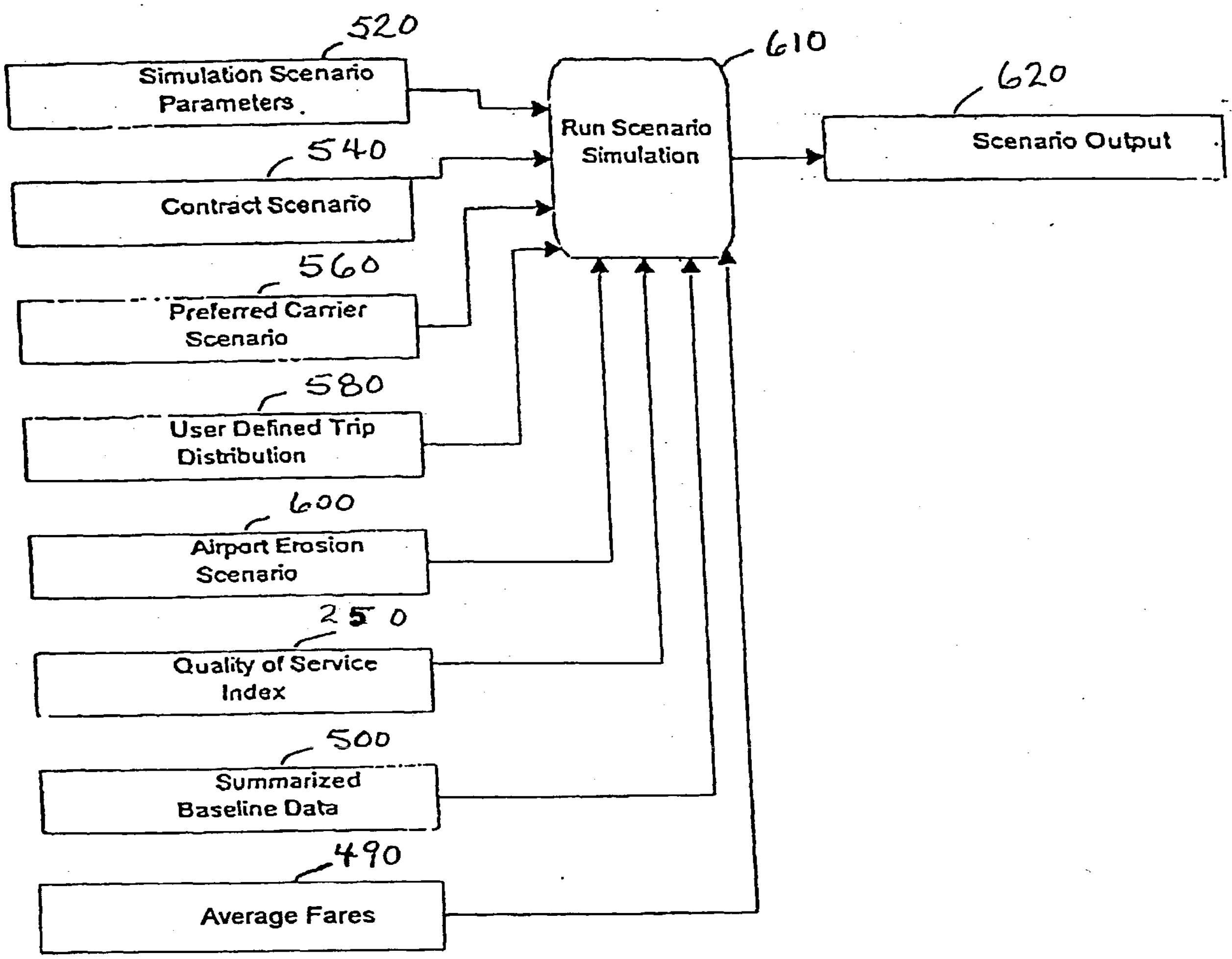
520
Simulation Scenario Parameters
540
Contract Scenario
560
Preferred Carrier Scenario
580
User Defined Trip Distribution
600
Airport Erosion Scenario
250
Quality of Service Index
500
Summarized Baseline Data
490
Average Fares
610
Run Scenario Simulation
620
Scenario Output

FIG. 6

INTERNATIONAL SEARCH REPORT

International application No.
PCT/US01/05132

A. CLASSIFICATION OF SUBJECT MATTER

IPC(7) : G06F 17/60
US CL : 705/5

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
U.S. : 705/5

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)
APS

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category *	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	US 5,832,453 A (O'BRIEN) 3 November 1998 (03.11.1998), column2, lines 5-11, column 4, lines 1-13, column 4, lines 25-35, column 4, lines 48-53, column 7, lines 5-23.	1

☐ Further documents are listed in the continuation of Box C. ☐ See patent family annex.

* Special categories of cited documents:

"A" document defining the general state of the art which is not considered to be of particular relevance

"E" earlier application or patent published on or after the international filing date

"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)

"O" document referring to an oral disclosure, use, exhibition or other means

"P" document published prior to the international filing date but later than the priority date claimed

"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention

"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone

"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art

"&" document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
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Name and mailing address of the ISA/US Commissioner of Patents and Trademarks Box PCT Washington, D.C. 20231 Facsimile No. (703)305-3230	Authorized officer Tariq R Hafiz James R. Matthews Telephone No. (703) 305-3900

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WO 01/61607 A1

(54) Title: COMPUTERIZED MODELING SYSTEM AND METHOD

(57) Abstract: A modeling system and method for describing large volume purchasing of travel services and for predicting shifts in service supplier market and shares that are dependent on changes in the volumes of purchases by a purchaser of travel services. The system and method uses input travel service provider data to calculate quality of service indices and uses those calculated results with input travel service purchaser data to generate scenario models describing large volume purchasing of travel services and to calculate predicted shifts in service supplier market shares as caused by input changes in the volumes of purchases by a purchaser of travel services. The predicted shifts in service supplier market shares are used to negotiate agreements between service purchasers and suppliers, and to monitor achievement of performance goals.

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